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14. ABSTRACT The introduced house centipede <i>Scutigera coleoptera</i> (L.) (Scutigermorpha: Scutigeridae) is found throughout North America and is recognized as the only scutigermorph in most of the United States and Canada. I report on the discovery of a population of the Japanese house centipede, <i>Thereuonema tuberculata</i> (Wood), from a military schoolhouse building in Ohio. <i>Thereuonema tuberculata</i> were collected for several years. Heightened scrutiny is called for on identifications of <i>S. coleoptera</i> throughout North America to differentiate this species from <i>T. tuberculata</i> .					
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Notes and Discussion Piece

Discovery of an Exotic Population of *Thereuonema tuberculata* (Chilopoda: Scutigermorpha), the Japanese House Centipede, in Ohio, U.S.A.

ABSTRACT.—The introduced house centipede *Scutigera coleoptera* (L.) (Scutigermorpha: Scutigeridae) is found throughout North America and is recognized as the only scutigermorph in most of the United States and Canada. I report on the discovery of a population of the Japanese house centipede, *Thereuonema tuberculata* (Wood), from a military schoolhouse building in Ohio. *Thereuonema tuberculata* were collected for several years. Heightened scrutiny is called for on identifications of *S. coleoptera* throughout North America to differentiate this species from *T. tuberculata*.

INTRODUCTION

With the exception of a few species in the far southern United States (U.S.A.), the only centipede in the order Scutigermorpha found throughout North America is *Scutigera coleoptera* (L.) (Scutigeridae), the “house centipede” (Mercurio, 2010). *Scutigera coleoptera* was presumably introduced from the Mediterranean region (Mercurio, 2010) and an early junior synonym *Scutigera forceps* Rafinesque was named from North America in 1820 (Rafinesque, 1820). Specimens could have even been collected earlier than the 1820s (Bollman, 1893). *Scutigera coleoptera* is synanthropic found in urban habitats and lives indoors in much of the U.S.A. and Canada (Kevan, 1983). This species has also been documented in Bermuda from the 1800s and early 1900s (Chamberlin, 1920). Stoev *et al.* (2010) consider *S. coleoptera* the most common synanthropic introduced centipede in Europe but it is restricted to living in buildings in colder areas.

Identification of Scutigermorpha to species throughout most of the U.S.A. and Canada is a short process. For example regional keys to the centipedes of the north-central United States clearly present *S. coleoptera* as the only Scutigermorpha (Summers, 1979). Because of this, most Scutigermorpha in North America will be quickly identified as *S. coleoptera* and require no microscopic or molecular examination.

In Asia *Thereuonema tuberculata*, the Japanese house centipede, might be synanthropic throughout parts of its native range from China through Japan and superficially resembles *S. coleoptera* (Nakanishi *et al.*, 2015; Wang, 1945). Both species are predatory or scavenge recently dead arthropods and small animals.

The Epidemiology Consult Service in the U.S. Air Force School of Aerospace Medicine houses an entomology section with one entomologist. The entomologist identifies arthropods and provides consultations to the military about arthropod pests and disease vectors. In 2011 the Epidemiology Consult Service relocated from Brooks City Base, Texas, U.S.A., to a newly constructed building (#840) on Wright-Patterson Air Force Base, Ohio, U.S.A. This newly constructed building houses the majority of the School of Aerospace Medicine including rotating U.S.A. and international students, medical, chemical, and radiological laboratories, response teams, and a shipping and receiving warehouse to support these operations. On an unrecorded date in late summer or early fall 2011, military personnel submitted scutigermorph centipedes from building #840 for identification. These were identified as *S. coleoptera* following the established report that this was the only scutigermorph found in the northern U.S.A. or Canada (Summers, 1979). No detailed examination was made with microscopy and most specimens were either destroyed or released. Recent molecular and careful morphological study has changed the identification of the centipedes.

METHODS

On 28 Apr. 2016, a freshly killed scutigermorph centipede was submitted by a military service member from building #840 for identification. The centipede was killed by blunt trauma prior to submission and stored at room temperature. In a serendipitous turn of events, I was conducting molecular research with scolopendromorph centipedes. The scutigermorph was included in a molecular analysis as an out-group.

To avoid contamination with gut contents, the intact head was removed from the centipede and macerated with a polypropylene pestle in a sterile microcentrifuge tube. Genomic nucleic acids were extracted from the macerated head with a Maxwell® 16 Viral Total Nucleic Acid Purification Kit (Promega, Madison, Wisconsin) following the manufacturer's protocol. A fragment of the cytochrome oxidase I gene was amplified by PCR from the extracted nucleic acids using primers LCO1490/HCO2198 and following the protocols by Folmer *et al.* (1994). A water negative control and a positive control consisting of a genomic extract from *Culex pipiens* were used. PCR products were detected using SYBR-Safe 2% gel electrophoresis with ultraviolet light. PCR products were then cleaned up using the QIAquick PCR Purification Kit (Qiagen, Valencia, California). Sequencing reactions were done with PCR primers using a BigDye Terminator v3.1 Cycle Sequencing Kit (Applied Biosystems, Foster City, California), and excess dye was removed by ethanol precipitation. Sequences were determined using an ABI 3100 capillary sequencer (Applied Biosystems, Foster City, California), by DNA Analysis, LLC (Cincinnati, Ohio). Primer sequences were removed and the sequences aligned and assembled with ClustalW (Kyoto University Bioinformatics Center, Japan) and compared to sequences in GenBank using the BLAST program (NCBI, Bethesda, Maryland).

Voucher specimens were deposited in the Ohio State University Museum of Biological Diversity, Columbus, Ohio; Harvard Museum of Natural History, Cambridge, Massachusetts; and Natural History Museum, London, United Kingdom.

RESULTS

The results of the BLAST analysis were a 100% match for *Thereuonema tuberculata* (Wood) (Genbank #: DQ222173). This result was unexpected and the sample was re-amplified by PCR and reanalyzed. The second set of results was identical. Unfortunately, the badly damaged headless carcass had already been discarded. On subsequent weeks from 28 Apr. until 10 June 2016, building #840 and other neighboring buildings were searched for scutigermorph centipedes. Seven additional specimens were discovered throughout the building, both dead and alive. The centipedes were carefully examined with a light microscope. All scutigermorph centipedes from building #840 were morphologically identified as *Thereuonema* based on the characteristic thread or needle-like spines on their tergites on their tergites. This character is well represented in an electron micrograph "Figure 2F therein" by Edgecombe and Giribet (2006). In addition several *S. coleoptera* were collected in houses around the base by residents. These centipedes share the morphologic characters of *Scutigera*, not *T. tuberculata*.

DISCUSSION

Based on specimens collected and submitted from 2011–2016, there is strong evidence that a population of *T. tuberculata* is established in at least one building in Ohio. Both adult and immature centipedes were collected on four floors of the building in a wide range of rooms including a library, food services area, shipping warehouse, laboratories, and office spaces. The original source of the population is unknown. Material and equipment moved to Ohio from Texas. There are daily shipments of materials into the warehouse from vendors. Students travel from across the U.S.A. and world for classes but do not live in the building. Numerous adjacent buildings on the military base are often connected with underground conduits, and there is heavy traffic between buildings.

Thereuonema tuberculata is endemic to Asia (Wümlli, 1975). It has been discovered in Europe and established a population in a warehouse in the United Kingdom (Barber, 2011). Whether this species can be invasive or has already spread in North America is unknown. The presence of at least one reproducing population of *T. tuberculata* in North America means that identifications of *S. coleoptera* without careful examination are suspect. The only reason this population was detected was an accident while conducting molecular studies. Morphological separation of *T. tuberculata* versus *S. coleoptera* can be accomplished with a dissecting microscope on specimens in liquid preservatives or dry. The tergites of *T. tuberculata* have small thread- or needle-like spines, while *S. coleoptera* does not. I encourage museum curators to examine material in their collections. The true range of *T. tuberculata* outside of Asia is unknown but might include both the United Kingdom and North America.

Acknowledgments.—I thank the staff in the janitorial, logistics, and library at building #840 at Wright-Patterson Air Force Base for submitting centipedes for identification. I especially thank Capt. E. Foley for laboratory assistance, and Drs. Giribet and Edgecombe were instrumental in assisting with morphological identification of specimens. Dr. Edgecombe verified the identification of the voucher specimens.

The views expressed in this article are those of the author and do not necessarily reflect the official policy or position of the Air Force, the Department of Defense, the Department of Agriculture or the U.S. Government. Approved for public release; distribution is unlimited Case number 88ABW-2016-3721 on 27 July 2016.

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